

Number Theory and Algebraic Geometry

ICM sectional workshop, ETH Zürich, July 11th–14th 2022

Program

Start	End	Mon 11th		Tue 12th		Wed 13th		Thu 14th	
07:30	09:00	Registration/Welcome coffee Foyer E-Süd							
		Lecture hall HG F1	Lecture hall HG F3	Lecture hall HG F1	Lecture hall HG F3	Lecture hall HG F1	Lecture hall HG F3	Lecture hall HG F1	Lecture hall HG F3
09:00	09:15	Calegari	Brentjes & Proust (May Prize)	Vigneras	Aganagic	Viazovska (Fields)	Kazhdan	Andreev (Leelavati Prize I)	Buzzard
09:15	09:30								
09:30	09:45								
09:45	10:00								
10:00	10:15	Coffee break		Coffee break		Coffee break		Coffee break	
10:15	10:30	Kaletha	Bayer & Macri	Guionnet (pl)	Habegger	Gamburd	Stroppel (pl)	Andreev (Leelavati Prize II)	Gupta
10:30	10:45								
10:45	11:00								
11:00	11:15								
11:15	11:30								
11:30	11:45	Loeffler & Zerbes	Krichever (pl)	Varju	Klingler	Sug Woo Shin	Fantechi	Ichino	Huh (Fields)
11:45	12:00								
12:00	12:15								
12:15	12:30								
12:30	12:45	Lunch break		Lunch break		Lunch break		Lunch break	
12:45	13:00								
13:00	13:15								
13:15	13:30	Dasgupta & Kakde	Asok & Fasel	Silverman	Efimov	Xinwen Zhu	Hausel	Guth (pl)	Li
13:30	13:45								
13:45	14:00								
14:00	14:15								
14:15	14:30	Pierce	Gabber	Koukou- lopoulos	Levine	Tian	Zograf	Caraiani	Jitomirs- kaya (pl)
14:30	14:45								
14:45	15:00								
15:00	15:15	Coffee break		Coffee break		Coffee break		Coffee break	
15:15	15:30			Wood	Pixton				
15:30	15:45	Bhatt (pl)				Gentry (pl)	Van Den Bergh	Coffee break	
15:45	16:00								
16:00	16:15								
16:15	16:30								
16:30	16:45								
16:45	17:00	Maynard (Fields)	Kuznetsov (pl)	Soundara- rajan (pl)	Duminil- Copin (Fields)	Conference photo at 16.45 on the polyterrace		Sakellaridis	Wittenberg
17:00	17:15								
17:15	17:30								
17:30	17:45								
						Drinks reception from 17.00-18.30 on the polyterrace		Beuzart- Plessis	Prokhorov

Combined in-
person & virtual

Live screening of
virtual talk

Screening of
recording

In-presence talk
only

Sectional Speaker: Bayer Arend
Sectional Speaker: Macrì Emanuele
Track: Algebraic Geometry

Wall-crossing in Algebraic Geometry

We discuss applications of Bridgeland stability conditions and wall-crossing in algebraic geometry.

Sectional Speaker: Zerbes Sarah
Sectional Speaker: Loeffler David
Track: Number Theory

Euler systems and the Bloch-Kato conjecture for automorphic Galois representations

The Bloch–Kato conjecture is a very general conjecture relating special values of L-functions to Selmer groups of Galois representations, generalising many earlier results and conjectures such as the Birch–Swinnerton-Dyer conjecture for elliptic curves. One of the most powerful tools available for attacking this conjecture is the theory of Euler systems, which are certain compatible families of cohomology classes which serve to bound the sizes of Selmer groups. In a series of recent works (variously joint with Lei, Pilloni, and Skinner), we have made new breakthroughs in the construction of Euler systems, combining the geometry of Shimura varieties with the representation theory of spherical pairs over local fields; and developed new techniques for proving explicit reciprocity laws, relating Euler systems to critical values of L-functions. We recently used these techniques to prove the Bloch–Kato conjecture in analytic rank 0 for critical values of the degree 4 L-function of $\mathrm{GSp}(4)$, and hence obtain new results towards the Birch–Swinnerton-Dyer conjecture for modular abelian surfaces. We will describe this result and work in progress to generalise it to a range of other automorphic L-functions.

Sectional Speaker: Asok Aravind
Sectional Speaker: Fasel Jean
Track: Algebraic Geometry

Vector bundles on algebraic varieties

We survey some recent progress in the theory of vector bundles on algebraic varieties and related questions in algebraic K-theory.

Sectional Speaker: Dasgupta Samit
Sectional Speaker: Kakde Mahesh
Track: Number Theory

On the Brumer-Stark conjecture and refinements

Let H be a finite abelian C/M extension of a totally real number field F . The Brumer-Stark conjecture states that an appropriately smoothed and depleted Stickelberger element attached to the extension H/F annihilates an associated ray class group of H . Over the past decades, many interesting refinements of the conjecture have been stated. In this talk we discuss our proof of the original Brumer–Stark conjecture and many of these refinements over $\mathbb{Z}[1/2]$. Further, we will discuss applications to explicit class field theory for totally real fields.

Sectional Speaker: Gabber Ofer
Track: Algebraic Geometry

Bounding the torsion in the l-adic cohomology of smooth projective varieties without unbound searches

Using a Hard Lefschetz estimate and arguments with l-adic Lie groups we obtain a presumably primitive recursive bound for the torsion in the l-adic cohomologies of smooth projective varieties over finite fields, improving the algorithm of Wittenberg described by Poonen et al.

Sectional Speaker: Pierce Lillian

Track: Number Theory

The hedgehog and the fox

In this talk, we will encounter an array of recent theorems, questions, and phenomena that can be profitably considered from viewpoints originating in the borderland between number theory and analysis.

Sectional Speaker: Kuznetsov Alexander

Track: Plenary

Homological algebraic geometry

The idea of studying the geometry of an algebraic variety through the structure of its derived category of coherent sheaves goes back to the pioneering works of Bondal and Orlov on the verge of the millennium. One of the central concepts of this approach is that of a semiorthogonal decomposition. In my talk I will overview the (rapidly developing) story of semiorthogonal decompositions, touching on some of its most fascinating aspects: (1) Semiorthogonal components with interesting properties and their geometric significance; (2) Categorical extensions of classical geometric constructions (homological projective duality, categorical joins and cones, categorical resolutions of singularities); and (3) Completely new constructions such as categorical absorptions of singularities.

Sectional Speaker: Habegger Philipp

Track: Number Theory

The Number of Rational Points on a Curve of Genus at Least Two

Let C be a smooth projective curve of genus at least 2 defined over the field of rational numbers. By the Mordell Conjecture, proved by Faltings, C has at most finitely many rational points. I will survey recent results regarding upper bounds for the number of such of rational points.

Sectional Speaker: Klingler Bruno

Track: Algebraic Geometry

Hodge theory, between algebraicity and transcendence

The Hodge theory of complex algebraic varieties is at heart a transcendental comparison of two algebraic structures. We survey the recent advances bounding this transcendence, obtained mainly through the use of o-minimal geometry.

Sectional Speaker: Koukoulopoulos Dimitris

Track: Number Theory

Rational approximations of irrational numbers

View abstract: <https://www.react-profile.org/upload/KIT/system/uploads/Koukoulopoulos.pdf>

Sectional Speaker: Pixton Aaron

Track: Algebraic Geometry

The double ramification cycle

The double ramification cycle parametrizes curves of genus g admitting maps to the projective line with specified ramification profiles over two points. I'll present a formula (proved in 2016) expressing this cycle in terms of tautological classes on the moduli space of stable curves. I will then discuss some of the applications and generalizations of this formula from the last few years.

Sectional Speaker: Soundararajan Kannan

Track: Plenary

The Distribution of Values of Zeta And L-Functions

I will survey recent progress on understanding the distribution of values of zeta and L-functions. In particular, I will discuss the problem of moments of $|\zeta(1/2 + it)|$ and moments of central values of L-functions, where the last twenty five years have seen a conjectural understanding of the asymptotics of these moments, together with progress in obtaining good upper and lower bounds in many situations.

Sectional Speaker: Gamburd Alexander

Track: Number Theory

Arithmetic and dynamics on varieties of Markoff type

The Markoff equation $x^2 + y^2 + z^2 = 3xyz$, which arose in his spectacular thesis (1879), is ubiquitous in a tremendous variety of contexts. After reviewing some of these, we will discuss (briefly) Hasse principle, asymptotics of integer points, and (in some detail) recent progress towards establishing forms of strong approximation on varieties of Markoff type, as well as ensuing implications, diophantine and dynamical.

Sectional Speaker: Fantechi Barbara

Track: Algebraic Geometry

A classical view on derived algebraic geometry

Since the turn of the millennium, higher categorical methods have been developed and successfully applied to a number of geometrical contexts, including algebraic geometry. We present some remarks on the necessity of bridging the gap between those who are fluent in the new language, and those who would benefit from it while working in a classical context, as well as suggesting possible approaches to do so.

Sectional Speaker: Hausel Tamas

Track: Algebraic Geometry

Enhanced mirror symmetry for Langlands dual Hitchin systems

I will survey enhanced mirror symmetry phenomena between Langlands dual Hitchin systems. Then I will discuss a coherent framework for understanding their classical limit.

Sectional Speaker: Gupta Neena

Track: Algebraic Geometry

On Generalised Asanuma Varieties

The solution to the Zariski Cancellation Problem was achieved by the study of a threefold constructed by Asanuma. In this talk, I will introduce a generalised version of the Asanuma threefold and discuss several necessary and sufficient criteria for the generalised Asanuma variety to be isomorphic to the affine space.

Sectional Speaker: Ichino Atsushi

Track: Number Theory

Theta lifting and Langlands functoriality

We review various aspects of theta lifting and its role in studying Langlands functoriality. In particular, we discuss realizations of the Jacquet-Langlands correspondence and the Shimura-Waldspurger correspondence in terms of theta lifting and their arithmetic applications.

Sectional Speaker: Li Chi

Track: Algebraic Geometry

Canonical Kaehler metrics and stability of algebraic varieties

We survey some recent developments in the study of canonical Kähler metrics on algebraic varieties and their relation with stability in algebraic geometry.